

# **DC MAGNETIC BLOW-OUT, HEAVY DUTY CONTACT RELAY PN-150BM**

## **Part Numbers**

<b>N322517-</b>	<b>001</b>	<b>002</b>	<b>003</b>	<b>004</b>	
<b>N322524-</b>	<b>001</b>	<b>002</b>	<b>003</b>		
<b>N322525-</b>	<b>001</b>	<b>002</b>		<b>004</b>	<b>006</b>

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## **1.1 INTRODUCTION**

This manual provides service information for the PN-150BM plug-in relay. The PN-150BM relay is a biased relay that has magnetic blowout contacts. These contacts can carry 15 amperes. This relay is used to control electric switch machines.

The design of the PN-150BM relay conforms to all applicable AREMA specifications.

## **1.2 SHOCK INDICATORS (N322524-001)**

### **WARNING:**

**Any relay showing Shock Indicator activation should be shipped before placing relay into service. Failure to assure proper function of this relay may result in severe personal injury or death.**

The shock indicator (P/N J680167-0012) shows red when the relay has been subjected to shock in excess of a safe level (i.e., dropped) during shipment or transport. This is an indication that the relay may have mechanical damage and may not meet electrical specifications.

The relay should be opened and visually inspected for damage (i.e., kinked springs). Mechanical settings should be checked, recalibrated, and tested according to specifications by a qualified individual.

## **1.3 R.A.I.L. TEAM AND TECHNICAL SUPPORT**

The *Rapid Action Information Link (R.A.I.L.) Team* is comprised of experienced product and application engineers ready to assist and resolve technical issues concerning any US&S product.

Any questions regarding the contents of this Service Manual can be answered by contacting the R.A.I.L. Team via e-mail at [railteam@switch.com](mailto:railteam@switch.com) or a toll-free call to 800-652-7276.



## **1.4 DESCRIPTION**

### **1.4.1 General**

The PN-150BM plug-in relay is a biased relay used in control of electric switch machines. The relay is factory calibrated to operate across a wide environmental range. All moving parts are enclosed in a sturdy, transparent, dust and moisture resistant cover. To ensure the relay is inserted in its proper mounting base, all relays have indexing pins. Relays lock securely in the plug-in position.

### 1.4.2 Coils

Refer to Subsection 1.5.2 to correlate part numbers to coil resistance values. The resistance selected depends on the system voltage and circuitry.

### 1.4.3 Contacts

Contacts of PN-150BM relays are heavy duty with silver-to-silver impregnated carbon fronts and silver-to-silver backs.

## 1.5 SPECIFICATIONS

The following paragraphs provide the electrical and mechanical specifications of the PN-150BM relays covered in this manual.

### 1.5.1 Mechanical

The following mechanical specifications are common to all PN-150BM relays covered in this manual.

TABLE 1-1: MECHANICAL SPECIFICATIONS

<b>Relay Dimensions:</b>	Height: 7-1/16" (17.93 cm)
	Width: 2-7/16" (6.19 cm)
	Depth: 8-3/8" (21.27 cm)
<b>Temperature:</b>	-40°F (-40°C) to +185°F (85°C)
<b>Indexing:</b>	Refer to Section 2.3
<b>Weight:</b>	6.75 lbs (3.06 kg)
<b>Mounting Base:</b>	N376048 (old-style) for relays N322517-XXX
	N399689 (old-style) for relays N322524-XXX
	N432995 (old-style) for relays N322525-XXX
	N451376-0305 (improved style) for all above
<b>Mounting Base Weight:</b>	17.5 oz. (old-style)
	9.5 oz. (improved style)
<b>Mounting Base Dimensions:</b>	Height: 7-15/16" (20.16 cm)
<b>Width</b>	2-7/16" (6.19 cm)
<b>Depth</b>	2-7/16" (6.19 cm) old-style
<b>Depth</b>	1-25/32" (4.52 cm) improved style



**1.5.2 Electrical**

TABLE 1-2: RELAY ELECTRICAL SPECIFICATIONS

Part No. with Front Testing	Contacts		Coil Ohms	Energization		System Voltage
				Amps	Volts	
N322517-001	2F	Mag. H.D.	240	0.0209	5.02	10-16
N322517-002	2F	Mag. H.D.	11/25.5	0.216	2.38	*
N322517-003	2F	Mag. H.D.	400	0.01475	5.8	
N322517-004	2F	Mag. H.D.	1300	0.010	13.0	
N322524-001	2F, 2B	Mag. H.D.	240	0.025	6.0	10-16
N322524-002	2F, 2B	Mag. H.D.	400	0.0174	7.0	
N322524-003	2F, 2B	Mag. H.D.	2730	0.0066	18.0	24
N322525-001	3F	Mag. H.D.	240	0.025	6.0	10-16
N322525-002	3F	Mag. H.D.	400	0.0174	7.0	
N322525-004	3F	Mag. H.D.	1300	0.010	13.0	
N322525-006	3F	Mag. H.D.	220/220	0.037	8.2	10-16

Contacts - heavy duty silver-to-silver impregnated carbon front and silver-to-silver back, with magnetic blowouts.

TABLE 1-3: CONTACT ASSIGNMENTS

Contact Arrangement	Number	Type	
2F	1,2	F	Circuit Fronts toward + battery
3F	1,2,3	F	Circuit Fronts toward + battery
2F, 2B	1,2	F	Circuit Heels toward + battery
	3,4	B	Circuit Heels toward + battery

\* For use with FR HI-SHUNT Track Unit.

All relays are presently furnished with Lexan covers.

If relay has fronts only, the front contacts go toward positive. If relay has both fronts and backs, the heel contact goes toward positive.

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## **2.1 GENERAL**

Relays plug directly into a mounting base that is secured to a rack. The only installation instructions required are for the mounting base.

## **2.2 MOUNTING BASE**

Secure the mounting base directly to the rack using the hardware furnished. All wiring terminates at the rear of the mounting base to solderless terminals (receptacle contact springs).

Mounting base details are shown in Figures A-2 (Old-Style Base) and A-3 (Improved Base) of the Appendix.

## **2.3 RELAY INDEXING**

Relays are factory equipped with indexing pins to prevent insertion of an incorrect relay into a mounting base. Each relay is accompanied by an indexing plate, which is applied to the mounting base at the time of initial installation. A typical plug-in relay with indexing pins and base with indexing plate is shown in Figure 2-1.

The following data defines the indexing that has been established for relays covered by this manual.

- a. The index code always consists of four figures (such as 0001, 0002, or 0101) and is used for both the relay and the indexing plate on the mounting base.
- b. The index code for each relay can be determined from the relay part number and its suffix, which is marked on the nameplate attached to the front of the relay. The first two digits of the index code are the last two digits of the part number; and the second two digits of the index code are the last two digits of the suffix. The index number thus obtained should agree with the placement of the indexing pins in the numbered vertical rows on the back of the relay starting with the top pin and reading down.
- c. The index code for each mounting base is determined by the placement of the holes in the numbered vertical rows of the large white nylon indexing plate that is affixed to the front of the mounting base. This indexing plate should not be removed from the mounting base, unless it is damaged or the indexing is to be purposely changed to accommodate a relay of a different part number. Discard the indexing plate that comes in a bag tied to the handle of all new relays, unless it is needed for replacement of damaged indexing plate or for application to a new mounting base.

**WARNING**

**NEVER DRILL NEW HOLES IN A BASE INDEXING PLATE THAT WILL PERMIT APPLICATION OF RELAYS WITH DIFFERENT PART NUMBERS OR CHANGE INDEXING PINS ON THE BACK OF A RELAY UNLESS IT IS BEING CONVERTED TO A NEW PART NUMBER. OTHERWISE, A HAZARD WILL BE CREATED THAT MAY COMPROMISE SAFETY CIRCUIT FUNCTIONS.**

**2.4 RECEPTACLE CONTACT SPRINGS****2.4.1 Old-Style Base Only**

The mounting base will normally be equipped with the required quantity of J680165 solderless receptacle contact springs and will accommodate one or two #14 or #16 wires. However, it can be equipped with receptacle contact springs for one or two #10 or #12 wires (J680181), or for one or two #18 or #20 wires (J680179). Make certain which type of solderless receptacle contact springs accompanies the mounting base before proceeding with their installation.

**2.4.2 Improved One-Piece Base Only**

The one-piece mounting base with hardware (N451376-0305) includes a full complement of receptacle contact springs eighteen #10 (M451142-2703), four #14-16 (M451142-2702) for coil connection, mounting fasteners and tags.

Each solderless receptacle contact spring should be inspected for physical damage before proceeding with installation.

The following is recommended when installing solderless receptacle contact springs:

- a. Receptacle contact springs must be inserted into the base with the lock side down (Refer to Figure 2-2).
- b. Make certain that the lanced tab is slightly compressed as the receptacle contact spring is inserted along the top of the cavity. The lanced tab could have been bent during handling, and, therefore, might not provide the required contact pressure after the relay is inserted. If the lanced tab does not touch, pull it up slightly using fingers or a suitable tool.
- c. After insertion, pull firmly on the wire to make certain the receptacle contact spring is locked in the receptacle.

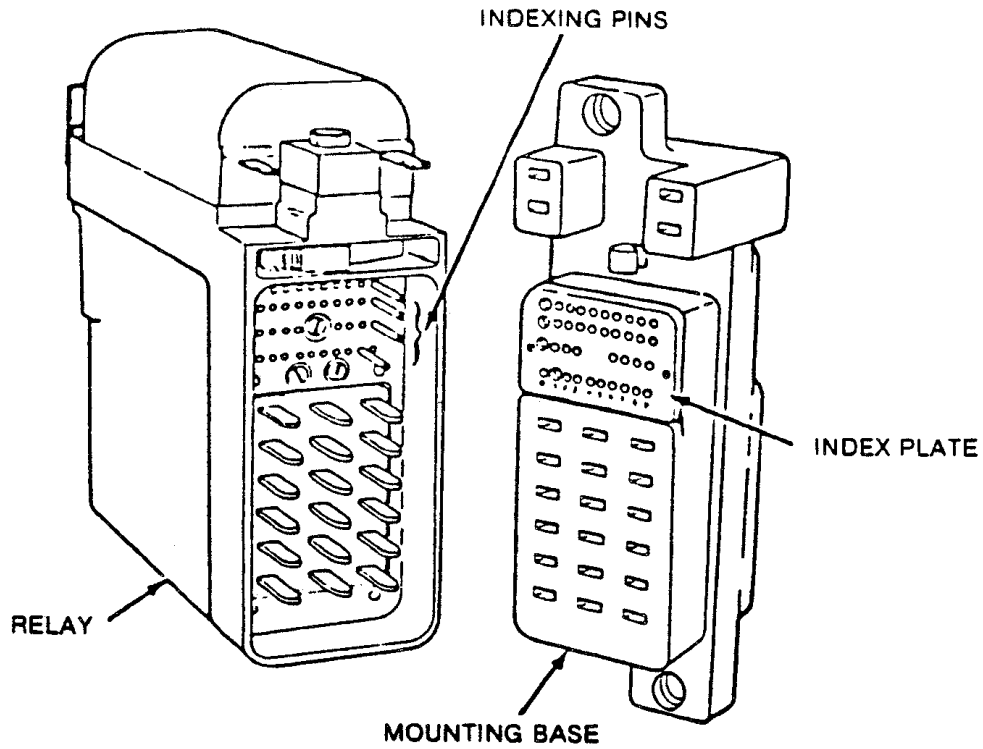


FIGURE 2-1. TYPICAL PLUG-IN RELAY AND MOUNTING BASE

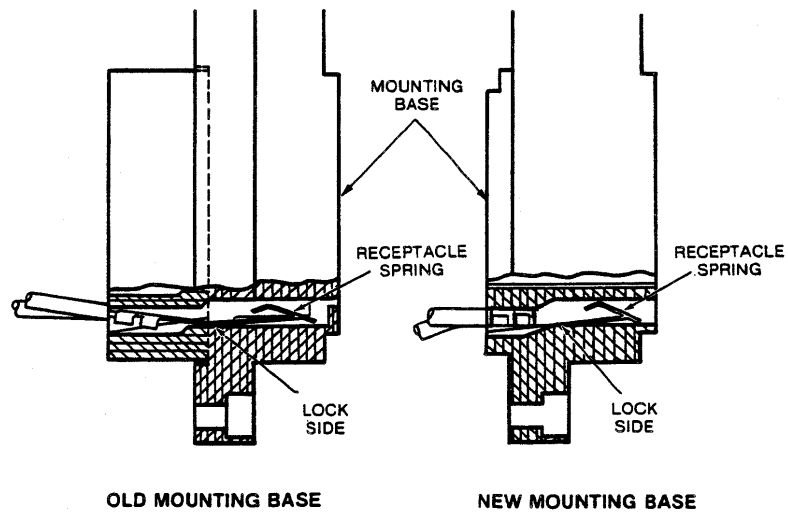


FIGURE 2-2. RECEPTACLE CONTACT SPRING INSTALLED

### 2.4.3 Installing Wires in Receptacle Contact Springs

Use the following procedure to ensure a good electrical and mechanical connection between the conductor wire and the receptacle contact spring. The following table identifies the correct crimping tool to be used when installing wires in receptacle contact springs.

TABLE 2-1 CRIMPING TOOLS

Crimping Tool	Wire Size	Old-Style	Improved Base
		Receptacle Contact Spring	Receptacle Contact Spring
J397138	#10/#12 AWG	J680181	M451142-2703
J397139	#14/#16 AWG	J680165 (Standard)	M451142-2702
J397188	#18/#20 AWG	J680179	M451142-2701

- Strip 3/16 in. (0.187 in. or 0.47 cm.) of insulation from the end of the wire.
- Place the receptacle contact spring into the jaws of the proper crimping tool.
- Partially close the crimping tool jaws against the receptacle contact spring to hold it in place. (Do not crush the receptacle contact spring barrel at this time.)
- Insert the stripped end of wire all the way into the receptacle contact spring barrel. Squeeze the tool handles until crimping is completed and the jaws release. Always attach the first wire to the longest terminal. This ensures that a second lead may be attached to the receptacle contact spring at a later time.
- Remove the crimped receptacle contact spring from the tool and inspect the connection. Make certain that the wire is flush with the crimped barrel and that there are no loose strands of wire.

### 2.4.4 Base Wiring

- Series or parallel connected coils

Some PN-150BM relay coils can be either series or parallel connected by externally wiring the mounting base (see Figure 2-3).

- Polarity of current through the magnetic blow-out contacts

#### CAUTION

It is imperative that the polarity of the current through the contacts of this relay be checked closely to agree with the polarity markings shown on the mounting base. If the polarity is not correct, the arc persisting between the contacts can seriously damage the relay.

TABLE 2-2 POLARITY MARKINGS

Relay	Base	Marking	
N322517-001 -002 -003 -004	N376048	+ On Front Contacts	- On Heels
N322524-001 -002 -003	N399689	+ On Heel Contacts	- On Front & Back Contacts
N322525-001 -002 -004 -006	N432995	+ On Front Contacts	- On Heels

## 2.5 RELAY INSERTION

Orient the relay to the mounting base with the push rod to the left-hand side; then plug the relay into the base. The relay should be pushed firmly against the mounting base while depressing the latch rod. After the relay is completely seated in the base, release the latch rod and pull on the handle to ensure that the relay has locked in place.

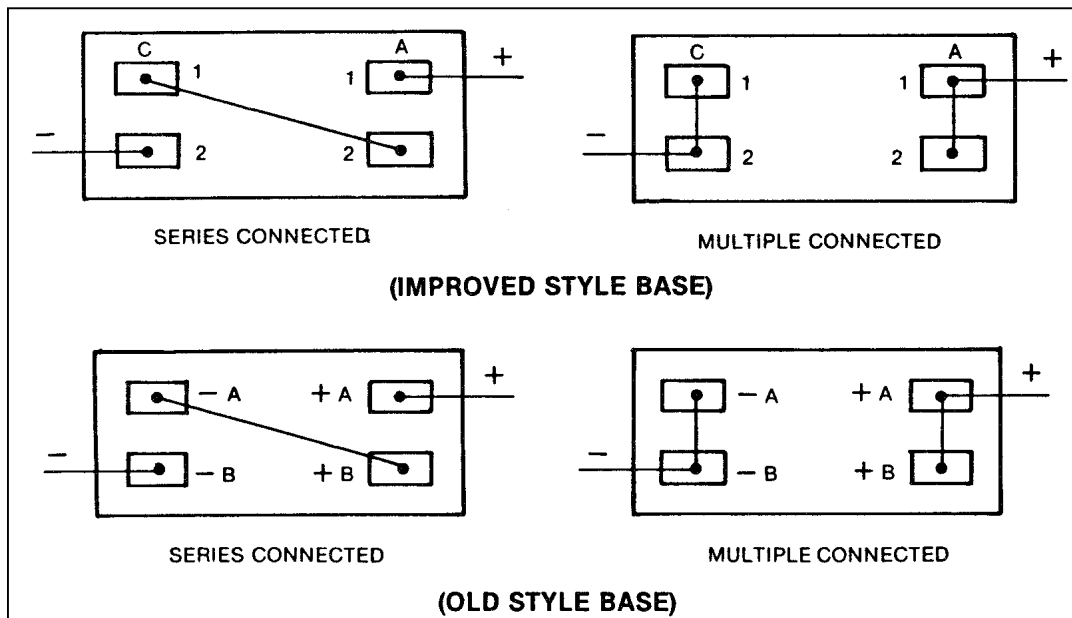


FIGURE 2-3. EXTERNAL CONNECTIONS TO MOUNTING BASE

## 2.6 VISUAL INSPECTION

On PN-150BM, P/N: N322524-XXX, as part of the final factory inspection, a dynamic operational test at rated capacity is performed that may cause a discoloration of the contacts and contact springs. This discoloration is normal and does not affect the proper operation of the relay.

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### **3.1 INTRODUCTION**

This section provides the necessary periodic preventive maintenance procedures that must be performed to ensure continuous, proper, and efficient operation of the PN-150BM relays covered in this manual. Field maintenance covers periodic inspections and performance tests.

### **3.2 PERIODIC PERFORMANCE TEST**

#### **3.2.1 Cleaning**

Before inspecting and testing the relay, if necessary use a soft cloth to clean the exterior to remove any dirt or dust that may have collected. A safe cleaning solution of alcohol and water or common laundry detergent may be used for removal of accumulated dirt, grease, etc.

#### **3.2.2 Service Requirements**

##### **3.2.2.1 General**

All vital relays must be inspected and tested at least every four (4) years. The tests and inspections are to include: pick-up current, drop-away current, timing of slow operating, contact resistance and timing relays; and visual inspection of contacts for damage or misalignment, corrosion or other contamination of parts, loose parts inside of the cover, broken seal, and cracked or broken cover.

Relays not passing the above-stated tests and inspections must be replaced and not returned to service until the operating characteristics and conditions are in accordance with US&S specifications.

##### **3.2.2.2 In-Service Test**

It is recommended that line relays in service be removed from service for shop repairs when one or more of the following conditions occur: (Use as a reference the calibration values given in Table 4-7 or 4-8.)

- a. Drop-Away value (D.A.) falls below 67% of the value given.
- b. Full-Drop-Away value (F.D.A.) falls below 33% of the value given.
- c. Full Stroke value (F.S.) increases to more than 110% of the value given.

##### **3.2.2.3 Test Procedures**

Test the operating characteristics of the PN-150BM relays as given in Section 4.6 Calibration.

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## 4.1 INTRODUCTION

This section provides the information necessary to perform shop level repairs of the PN-150BM relays covered in this manual. In general, relays arriving at the shop for repair have been checked in the field and have been found to perform unacceptably or have been physically damaged.

## 4.2 CLEANING AND INSPECTION

Before inspecting the relay and initiating repairs, carefully use a soft cloth to clean the exterior and to remove any dirt or dust that may have collected. A safe cleaning solution of alcohol and water or common laundry detergent may be used for removal of accumulated dirt, grease, etc.

Inspect the relay exterior for signs of physical damage, such as a cracked or broken cover, cracked or damaged housing, and damaged and/or missing contact block terminals and indexing pins. If severe damage is found, a careful inspection of the interior components should be made for physical damage.

Remove the cover and clean the surface between the armature and the pole faces, especially the stop pin area (see Figure 4-1), using a lint free cloth and alcohol.

Proceed with relay contact cleaning, using the following recommended cleaning materials:

### 4.2.1 Cleaning Relay Contacts

This section covers recommended methods for the preparation and cleaning of relay contacts.

TABLE 4-1 RECOMMENDED CLEANING MATERIALS

Recommended Cleaning Materials	
Burnishing Tool, P.K. Neuses Co. No. 3-316	J397187
Burnishing Tool, P.K. Neuses Co. No. N318 (Heavy Duty)	J397187-001
Paper Strip, strips cut from 67-pound white	
Springhill Vellum Bristol Paper	J793094
Also recommended (commercially available)	
Emery Paper, Wet or Dry, 600 Grit, cut in strips	
Alcohol #1 Solvent (Ethyl Alcohol Proprietary 190 or equal)	

### NOTE

**When using the paper strip, clean the back contacts first, then the front contacts last. Discard the paper strips when dirty.**

**4.2.1.1 General**

- a. Preliminary information

The cleaning tool should be used to clean no more than 12 front (carbon) and 12 back (silver) contacts after which it should be washed before re-use. The cleaning tool should be cleaned using a mild soap or detergent and water, rinsing thoroughly and allowing to dry.

**NOTE**

**In the final cleaning procedures outlined in the following sections, it is recommended that all silver contacts are cleaned first and then all silver impregnated carbon contacts. This will ensure that the silver tips are not contaminated with residue that might adhere to the cleaning strips from cleaning the silver impregnated carbon contacts.**

**4.2.1.2 Contacts That Are Burned**

- a. Using a 600-grit emery paper strip folded with the grit side out so that both contacts can be burnished simultaneously, stroke the contacts in the direction of contact wipe.
- b. Using the burnishing tool, stroke the contacts several times in the direction of contact wipe.
- c. Place the paper strip between the open contacts, then close the contacts and withdraw the paper strip.
- d. Repeat steps “c” several times if necessary.
- e. Using the Alcohol #1 Solvent (Ethyl Alcohol Proprietary 190 or equal), give the contacts a degreasing/wash.
- f. Place the paper strip between the open contacts, then close the contacts and withdraw the paper strip.
- g. Repeat steps “f” several times if necessary.

**4.2.1.3 Contacts with Heavy Tarnish, Slightly Rough or Pitted**

- a. Perform the procedure in Subsection 4.2.1.2, Steps “b” to “g”.

**4.2.1.4 Contacts with Surface Film or Oxidation (Not Pitted)**

- a. Perform the procedure in Subsection 4.2.1.2, Steps “f” and “g”.

### 4.2.2 ARMATURE STOP PIN CONDITION

The following instructions are for cleaning the armature stop pin (See Figure 4.1). This procedure should be followed wherever a relay is shopped for failure to meet its calibration specifications during scheduled field inspection and tests.

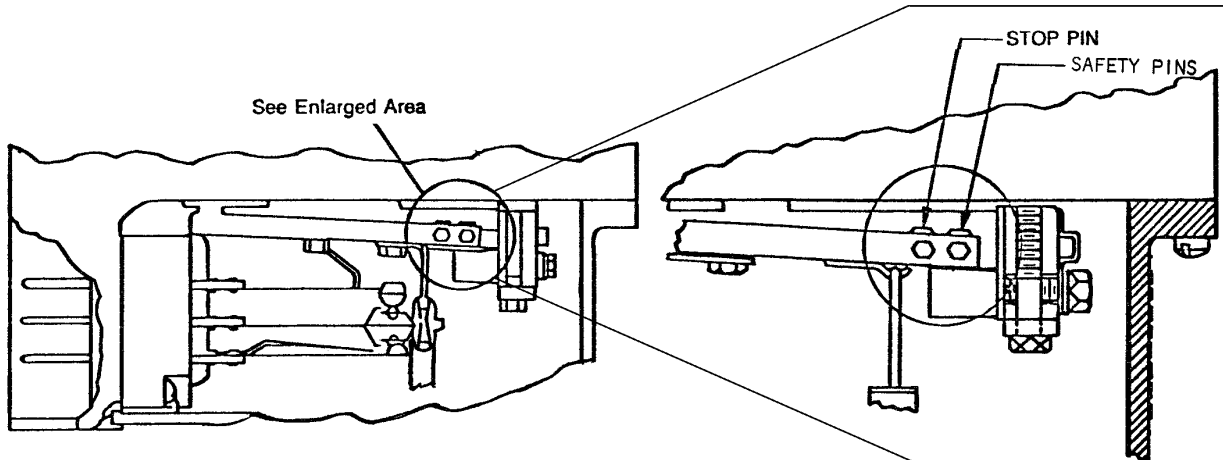


FIGURE 4-1. ARMATURE STOP PIN LOCATION

- a. After removing the cover, clean the stop pin and adjacent surface by saturating a paper strip (contained in J793094) with alcohol and placing it between the armature and pole face. Apply moderate pressure on the armature and draw the paper out. Continue until all residues are removed from the surfaces. Dry the surfaces using a clean strip of paper.
- b. Apply a dry lubricant, such as graphite, to the relay stop pin and its point of contact on the pole face.
  1. Insert the stop pin conditioning graphite stick (N451151-3203) between the armature stop pin and its point of contact on the pole face with the graphite against the stop pin. While applying moderate pressure on the stick, pull the stick back and forth in a circular motion over the stop pin for several seconds to ensure a sufficient amount of graphite transfer.

It is not necessary to observe a significant deposit of graphite, since most of what is required can only be determined by means of a microscope.

- c. Recheck relay calibration and prepare relay for return to service.

### 4.3 CHECK-OUT PROCEDURE (PERFORMANCE TEST)

Perform calibration in accordance with Section 4.6.

#### 4.4 REPAIRS AND REPLACEMENT

Since the contacts are the only wearing parts in this relay, in most cases the relay can be restored to proper operation by dressing (Section 4.2) and readjusting (Subsection 4.5.5) them.

##### 4.4.1 Recommended Tools

TABLE 4-2 RECOMMENDED REPAIR AND REPLACEMENT TOOLS

Twist Drill #42
Screw Driver Torque Measuring

##### 4.4.2 Disassembly

Dismantle the relay only to the degree necessary to complete repairs. Refer to the Appendix A - Parts List for part information and location. In general, to dismantle the plug-in relay proceed with the following sequence:

- a. Remove relay cover seal.
- b. Carefully remove plastic cover.
- c. Remove/disassemble relay components as required.
- d. Remove contacts/contact block as required.
- e. Remove permanent magnet as required.

#### NOTE

These magnets are of a special alloy that permits retention of proper strength indefinitely if not abused. When not in place on relays, magnet assemblies should be kept separated from other magnetic objects. The screws that hold the extension to the magnet should be kept tight. If a magnet becomes weakened, it should be returned to the factory for recharging by special equipment required to fully charge the magnet. It will then be aged to its best working strength.

##### 4.4.3 Reassembly

Reassembly is accomplished generally in the reverse order of disassembly. Do not overtighten or force parts when reassembling a relay. The following paragraphs provide additional instructions to be followed during reassembly of this relay.

Upon completion of reassembly, calibrate the relay as directed in Section 4.6.

#### **4.4.4 General Parts Replacement**

##### **4.4.4.1 Armature Air Gap**

The parallel air gap should be  $.023" \pm .002"$ . The minimum rear air gap between the armature and the clamping blocks for the horizontal hinge springs is  $.004"$  at its closest point. Reference Figure A1(A).

##### **4.4.4.2 Replacing Contact Block**

If the contact block is to be replaced by another, remove the old block and then use a small punch to remove the small dowel pins. Attach the new block with the four screws. Torque the contact block screws to  $10 (\pm 2)$  inch pounds. Run a #42 drill (0.0935 Dia.) through the dowel pinholes into the epoxy contact block for a total depth of  $9/16" + 1/32 - 0$ .

#### **NOTE**

**Replacement contact blocks MUST be of the same general design.**

Carefully install the dowel pins, tapping in until they are flush with the frame surface.

If it is necessary to install a used contact block from another relay, remove only one of the dowel pins from the aluminum frame. Carefully press the block on the remaining pin and fasten in place with the screws. One dowel pin will adequately hold the block in place. Install the contact block mounting screws and torque them to  $10 \pm 2$  inch pounds.

Do not overtighten or force parts when reassembling a relay. Upon completion of reassembly, calibrate the relay as directed in Section 4.6.

##### **4.4.4.3 Permanent Magnet Replacement**

The polarity of the magnet should be such that the top (end farthest from the two notched holes) will attract the end of a compass needle which points toward geographic South.

The permanent magnet assembly should be applied to the relay as shown in Figure 4-2, making sure that the shunt between the magnet and the magnet extension is touching the pole piece. Tighten the two long screws holding the magnet assembly to the pole piece sufficiently to straighten the curved strap against the magnet. Bend the nut locks securely up against the sides of the screw heads.

## 4.5 ADJUSTMENTS

All adjusting and testing must be done with the relay in its normal operating position.

### 4.5.1 Recommended Tools and Test Equipment

TABLE 4-3 - RECOMMENDED ADJUSTMENT TOOLS AND TEST EQUIPMENT

Item	Part Number
Gap Gauge - 0.001 in. to 0.250 in.	
Gram Gauge - 250 Grams	
Bending Tools	J397164 -0022 -0023 -0025 -0026

### 4.5.2 Permanent Magnet Extension

The permanent magnet extension should be adjusted so that it touches the two stop-pins on the bottom of the armature with the nominal spacer, specified in Test 1, Table 4-5 or 4-6, inserted and held firmly between the armature main stop pin and the upper pole face. If necessary in order to obtain calibration values or contact openings, this spacer may be varied within the limits given in Table 4-5 or 4-6.

### 4.5.3 Permanent Magnet

With the armature released, both back stop pins should make contact with the permanent magnet extension face, and neither should project over the edge of the permanent magnet. In this position, the air gap at the permanent magnet extension face should average 0.004 inch parallel and must not be less than 0.003 inch at any point. This is the physical air gap from plated extension face to plated armature.

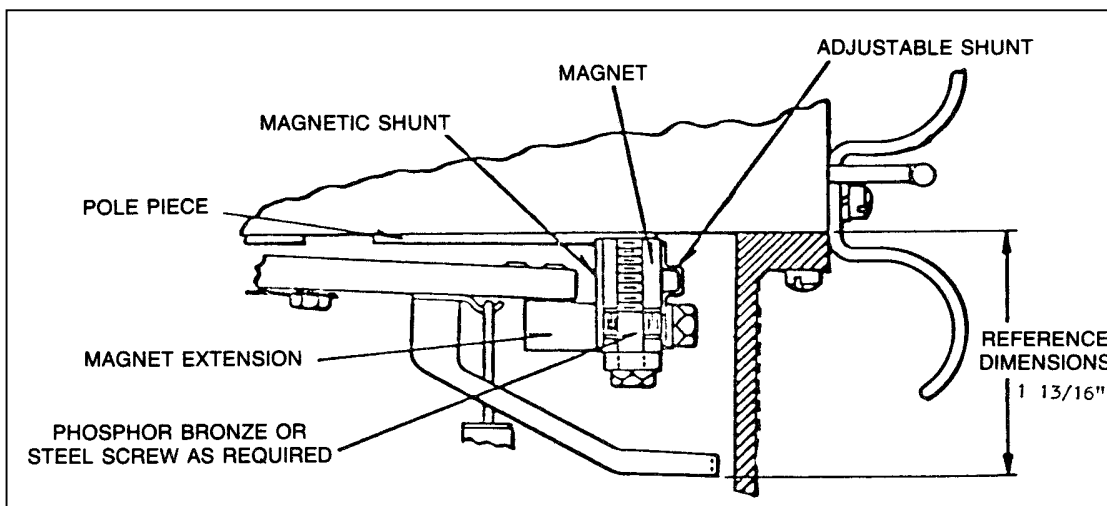


FIGURE 4-2. ASSEMBLY OF PERMANENT MAGNET



#### **4.5.4 Indicator**

Adjustment of the armature position indicator after calibration should be made so that the bottom of the red painted surface is 1-13/16 inches from the main body of the relay frame when the relay is deenergized. Viewed from the front of the relay with cover applied, the red indicator should be in full view with the armature in the deenergized position, and should be hidden with the armature in the energized position (see Figure 4-2).

#### **4.5.5 Contact Adjustment**

The fingers supporting the contact springs should be straight and approximately at right angles to the relay base. The heavy front and back contacts should be adjusted by bending in front of the brace rather than adjacent to the contact block using a bending tool (J397164-0022). The bending tool (J397164-0023) for the heels should be applied between the rivets.

Because of the effect of the weight of the contact tips, all checks of contact adjustment should be made with the relay in the normal upright position. Contact support fingers should be adjusted sideways by using the alignment tool (J397164-0026 for heels and J397164-0025 for fronts and backs) so that the contact tips on both members are approximately centered.

Contact surfaces should not be disturbed unless there is evidence of severe pitting from excessive loading or an accidental short through the contacts. In case contacts must be dressed, 600-grit emery paper should be used and this should be followed by the use of the burnishing tool and paper strip.

After the contacts are dressed and/or after adjustments have been made to meet calibration requirements, clean the contacts in accordance with the instructions in Section 4.2 of this manual.

##### **4.5.5.1 Heel Contact Springs**

###### **a. Original Design**

Before adjusting the heel springs, it should be determined that the dimensions exist as shown in Figure 4-3 for outside to outside across the flats of the depressions of the heel springs, where the slots of the operating arm rest. If they need adjusting, it is done by bending springs at the outer ends. After this adjustment, it **must** be determined the springs are pressing against each other at the two points indicated Figure 4-3 and that the free ends are aligned within 1/64 of an inch.

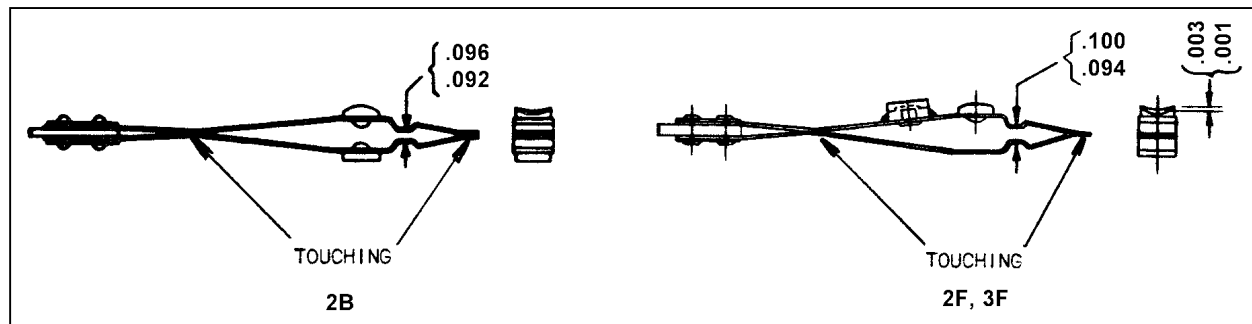


FIGURE 4-3. HEEL CONTACT SPRINGS

#### 4.5.5.2 Adjusting Front and Heel Contact Springs

Using the Test No. 2 values per Table 4-5 or 4-6 at the rear of this service manual, hold a gauge of the proper value firmly at the main stop pin by energizing the relay. Adjust the front contact springs so that light is just barely visible between the contact tips. A 0.003" thinner spacer should allow the contacts to close. Deenergize the relay and remove the gauge.

Remove the operating arm by slightly compressing the extreme front end of the heel springs and hold it clear from all heel springs. Adjust the heel spring members so that there is the appropriate clearance (Table 4-5 or 4-6) between the front contacts and the heel contact tips.

Replace the operating arm and work the armature by hand a few times to get the operating arm into its normal position. When replacing the operating arm, make certain that the same side is to the front, as reversing the arm may change adjustments because of slight warpages and molding tolerances. On later production arms the word "front" is molded on one side.

Reinsert the Test No. 2 gauge used above, energize the relay and readjust the front contact springs as before. Check that the Test No. 2 gauge allows the contacts to close.

Per Table 4-6, using the #3 Test (maximum) spacer held firmly between the magnet and the armature lower stop pins, adjust the back contact springs so that light is just barely visible between the contact tips.

Check that the #4 Test (minimum) spacer allows the contacts to close.

Again remove the operating arm and determine that the heel contacts have the appropriate clearance (Table 4-5 or 4-6).

**4.5.6 Hold-Down Force**

- a. With the relay in its normal upright position, energize the relay in its reverse direction (armature not picking up) to the Charge Value given in Table 4-7.
- b. Pole change to pick up the armature to full-stroke, and then deenergize the relay.
- c. At the bottom of the centermost contact driver, or at the bottom of the center of the molded driver, measure the upward force in grams to move the armature away from the permanent magnet.
- d. This is the “hold down grams” and must not be less than the value given in Table 4-5 and 4-6.

The hold down force can be increased, if necessary, by bending the shunting strip, which is fastened to its forward face, away from the permanent magnet. If one or both of the two vertical screws that fasten the permanent magnet assembly to the relay frame is steel, a further increase in hold-down force can be obtained by changing to bronze screws. The steel screw, J463078, has dull (tin) plating and its head is 3/32 inch thick. The bronze screw, M327179, has brighter (nickel) plating and its head is 1/8 inch thick.

Any change in the hold-down force will affect the relay calibration, as discussed in Section 4.6.

### 4.5.7 Contact Openings

In obtaining proper calibration, it is permissible to vary the adjustments given in the foregoing paragraphs. However:

- a. With the armature in its fully released position, the front contacts must be open at least 0.050 inch.
- b. When a front contact is just making, the corresponding back contacts must be open more than 0.020 inch.

## 4.6 CALIBRATION

### 4.6.1 Recommended Test Equipment

Nomenclature
Power Supply, 0-40 Vdc
Digital Multimeter (two required)
DPDT (double pole, double throw-S1)
SPST Switch (S2)

### 4.6.2 Calibration Procedure

Connect the circuit as shown in Figure 4-4, and proceed as follows:

- a. Set ammeter to appropriate current range.
- b. Set voltmeter to appropriate voltage range.
- c. Set DC power supply to appropriate output range.
- d. Set switch S1 to Normal.
- e. Turn DC power supply on, and close S2.
- f. The relay shall first be energized at the “Charge” value specified in Table 4-7 or 4-8, with Switch S1 in the Reverse position under which condition the armature must not pick up. The relay shall then be pole-changed several times ending in the Normal position under which condition the armature shall pick up.
- g. From the “Charge” value, the voltage shall be gradually reduced until the armature drops away to open all front contacts. This is the “Drop-Away” value, and it shall not be less than the minimum value specified in Table 4-7 or 4-8. The voltage shall then be further gradually reduced, if necessary, until the armature rests against the permanent magnet. This is the “Full Drop-Away” value, and it shall not be less than the minimum value specified.

- h. The voltage shall then be reduced to zero and, after opening the circuit for one second, gradually increased; and the value shall be noted at which the armature moves away from the permanent magnet. The armature should move away with a definite, sudden motion. The voltage shall be further increased until the front contacts close and the value noted. The voltage shall then be further increased, if necessary, until the armature stop pin closes against the pole face. This is the “Full Stroke” value, and it shall not exceed the maximum value specified.

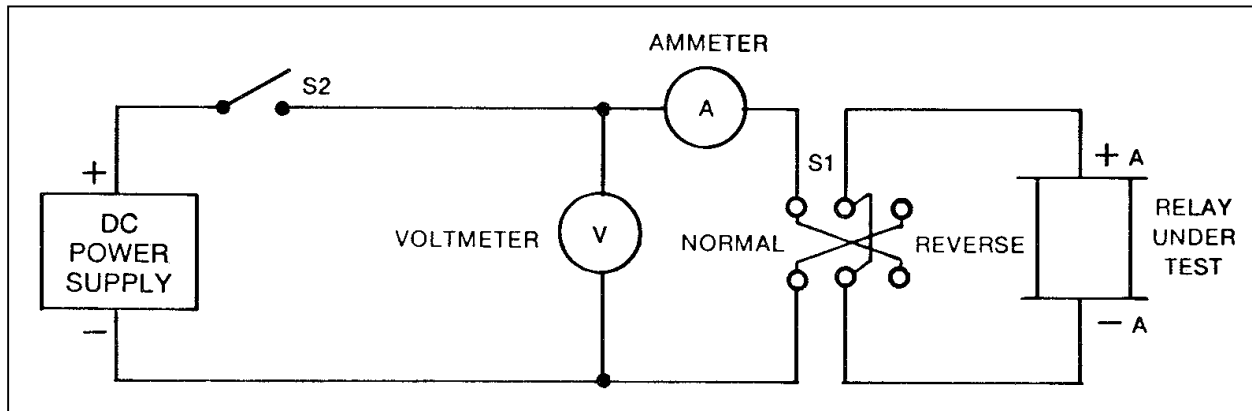


FIGURE 4-4. PN-150BM RELAY TEST CIRCUIT

#### 4.6.3 Contact Resistance

Resistance of front contacts should be measured with the armature in its full-stroke position, and resistance of back contacts should be measured with the armature fully released. Cleaned contact resistance should not exceed the following values.

TABLE 4-4 - CONTACT RESISTANCE

Type of Contacts	Ohms Front Contacts	Ohms Back Contacts
Silver to Silver-Impregnated Carbon	0.09	--
Silver to Silver	--	0.03

TABLE 4-5 - ADJUSTMENT AND CALIBRATION SUMMARY  
FOR N322517-XXX AND N322525-XXX PN-150BM RELAYS

Adjust using nominal spacers for test numbers 1-4 for all relays. If the hold-down force is too strong, use maximum spacers - or if too weak, use minimum spacers.

Test	Adjustment	Nom	Min	Max	Remarks
1.	Permanent Magnet Assembly	0.177"			Main stop-pin spacer for adjustment. Back stop-pins touching.
2a.	Front Contact Adjustment	0.046"	---	---	Main stop-pin spacer. Contacts just open.
2b.	Front Contact Adjustment	0.043"	---	---	Main stop-pin spacer. Contacts must close.
3a.	Front Contact Opening	0.100	---	---	Armature released against permanent magnet.
3b.	Front Contact Opening	---	0.030	---	With operating arms removed.
4.	Polarity Test	Charge Value			Plus lead on upper left mounting base receptacle (viewed from front) for pickup. With reversal, armature must stay down. Reverse several times.
5.	Drop-Away	---	Table 4-7 or 4-8	---	After charge. To close back contacts.
6.	Full Drop-Away	---	Table 4-7 or 4-8	---	After drop-away. Reduce current until armature rests on permanent magnet.
7.	Break-Away from Permanent Magnet	---	Table 4-7 or 4-8		Differential for Break-Away from permanent magnet to be less than actual Pick-Up.
8.	Pick-up (Front Contacts Make)	---	Table 4-7 or 4-8		It is permissible for Pick-up and Working to be the same.
9.	Working/Full-Stroke (To Stop-Pin).	---	---	Table 4-7 or 4-8	
10.	Hold-Down Torque	---	150 Grms.		Force on bottom contact engaging pin of operating arm to pull armature from permanent magnet after charge.
11.	Final Electrical Inspection				Recheck tests 6 to 11 with cover applied.

**TABLE 4-6 - ADJUSTMENT AND CALIBRATION SUMMARY FOR PN-150BM WITH 2F-2B  
MAGNETIC HEAVY DUTY CONTACTS (N322524-XXX)**

Adjust using nominal spacers for test numbers 1-4 for all relays. If the hold-down force is too strong, use maximum spacers. If the hold-down force is too weak, use minimum spacers.

<b>Test</b>	<b>Adjustment</b>	<b>Nom</b>	<b>Min</b>	<b>Max</b>	<b>Remarks</b>
1.	Permanent Magnet Assembly	0.250"	0.245"	0.255"	Main stop-pin spacer for adjustment. Back stop-pins touching.
2a.	Front Contact Adjustment	0.046"	--	--	Main stop-pin spacer. Contacts just open.
2b.	Front Contact Adjustment	0.043"			Main stop-pin spacer. Contacts must close.
3.	Back Contact Adjustment	0.041"	0.035"	0.045"	Back stop-pin spacer. Contact just open.
4.	Back Contact Compression Test	---	0.032	---	Spacer between permanent magnet and armature lower stop-pins.
5a.	Front Contact Openings	---	0.130"	---	With back contacts just closed.
5b.	Front Contact Openings	---	0.150"	---	Armature released against permanent magnet.
5c.	Back Contact Openings	---	0.030"	---	With operating arms removed.
5d.	Front Contact Openings	---	0.060"	---	With operating arms removed.
6.	Polarity Test	Charge Value			Plus lead on upper-left mounting base receptacle (viewed from front) for pickup. With reversal, armature must stay down. Reverse several times.
7.	Drop-Away	---	Table 4-8	---	After charge. To open Back Contacts.
8.	Drop-Away to Full Back Contact Pressure	---	Table 4-8	---	After drop-away. Reduce current until armature rests on permanent magnet.
9.	Break-Away from Permanent Magnet	---	Table 4-8		Differential for Break-Away from permanent magnet to be less than actual Pick-Up.
10.	Pick-up (Front Contacts Make)	---	Table 4-7 or 4-8		It is permissible for Pick-up and Working to be the same.
11.	Working/Full-Stroke (To Stop-Pin)	---	---	Table 4-8	
12.	Hold-Down Torque	---	150 Grms.		Force on bottom contact engaging pin of operating arm to pull armature from permanent magnet after charge.
13.	Final Electrical Inspection				Recheck tests 6 to 11 with cover applied.

TABLE 4-7 - CALIBRATION VALUES FOR PN-150BM RELAYS  
WITH 2F MAGNETIC HEAVY-DUTY CONTACTS  
(N322517-XXX)

Relay Resis.	Charge		Minimum Drop-Away		Full Drop -Away		Full Stroke	
Ohms	Amps	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
11	0.865	9.52	0.081	0.89	0.054	0.59	0.216	2.38
240	0.0835	20.0	0.00782	1.88	0.00521	1.25	0.0209	5.02
400	0.058	23.2	0.0054	2.16	0.0036	1.44	0.01475	5.8
1300	0.033	43.33	0.003	4.06	0.002	2.7	0.010	13.0

TABLE 4-8 - CALIBRATION VALUES FOR PN-150BM  
RELAYS WITH EITHER 2F - 2B OR 3F MAGNETIC HEAVY-DUTY CONTACTS  
(N322524-XXX AND N322525-XXX)

Relay Resis.	Charge		Minimum Drop-Away		Full Drop-Away		Full Stroke	
Ohms	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
240	0.0835	20.0	0.00782	1.88	0.00521	1.25	0.025	6.0
400	0.058	23.2	0.0054	2.16	0.0036	1.44	0.0175	7.0
1300	0.03	43.3	0.0031	4.06	0.0021	2.71	0.010	13.0
2730	0.0217	59.35	0.002	5.56	0.0014	3.7	0.0066	18.0
220/220	0.11	24.24	0.010	2.27	0.0069	1.52	0.037	8.2



**A.1 PARTS LIST FOR PN-150BM MAGNETIC HEAVY DUTY CONTACT RELAYS  
(N322517-XXX), (N322524-XXX), (N322525-XXX) (SEE FIGURE A1)**
**IMPORTANT NOTE**

Individual relay contacts are no longer available. If contact replacements are necessary, a molded block contact assembly containing a complete set of new contacts should be installed. The old-style "screw & wedge" contacts, if still in good condition, may be retained as replacements in relays still using such contacts.

Relay Pc. No.	No. Contacts	Coil Res-Ohms
N322517		
-001	2F Magnetic Heavy Duty	240
-002	2F Magnetic Heavy Duty	11/25.5
-003	2F Magnetic Heavy Duty	400
-004	2F Magnetic Heavy Duty	1300
N322524		
-001	2F, 2B Magnetic Heavy Duty	240
-002	2F, 2B Magnetic Heavy Duty	400
-003	2F, 2B Magnetic Heavy Duty	2730
N322525		
-001	3F Magnetic Heavy Duty	240
-002	3F Magnetic Heavy Duty	400
-004	3F Magnetic Heavy Duty	1300
-006	3F Magnetic Heavy Duty	220/220

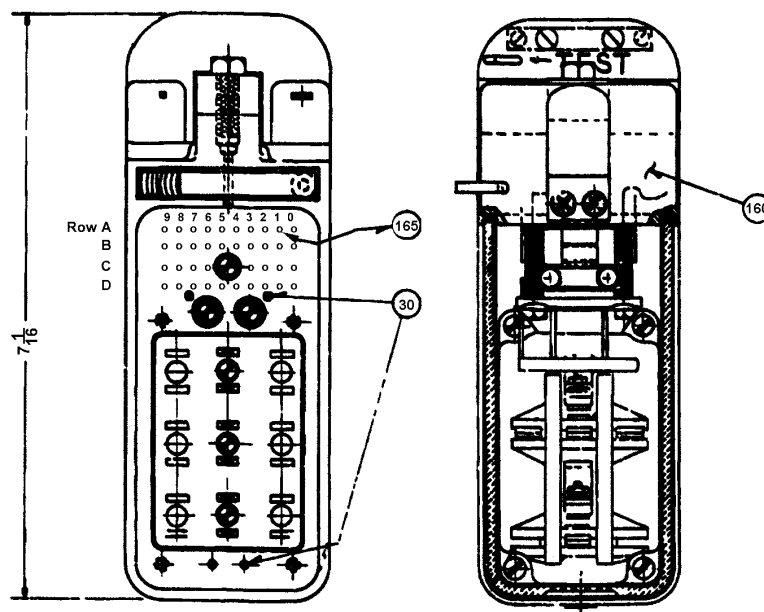


FIGURE A-1(A) PN-150BM RELAY PARTS LOCATION DIAGRAM

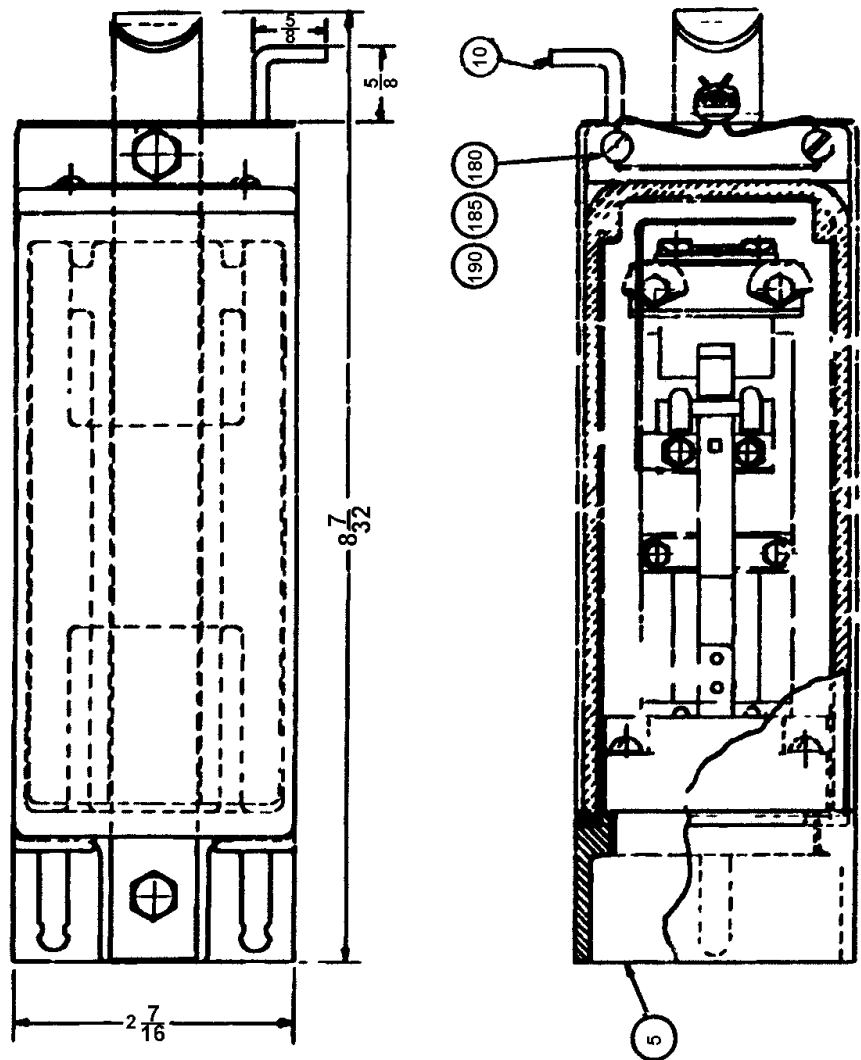


FIGURE A-1(B) PN-150BM RELAY PARTS LOCATION DIAGRAM

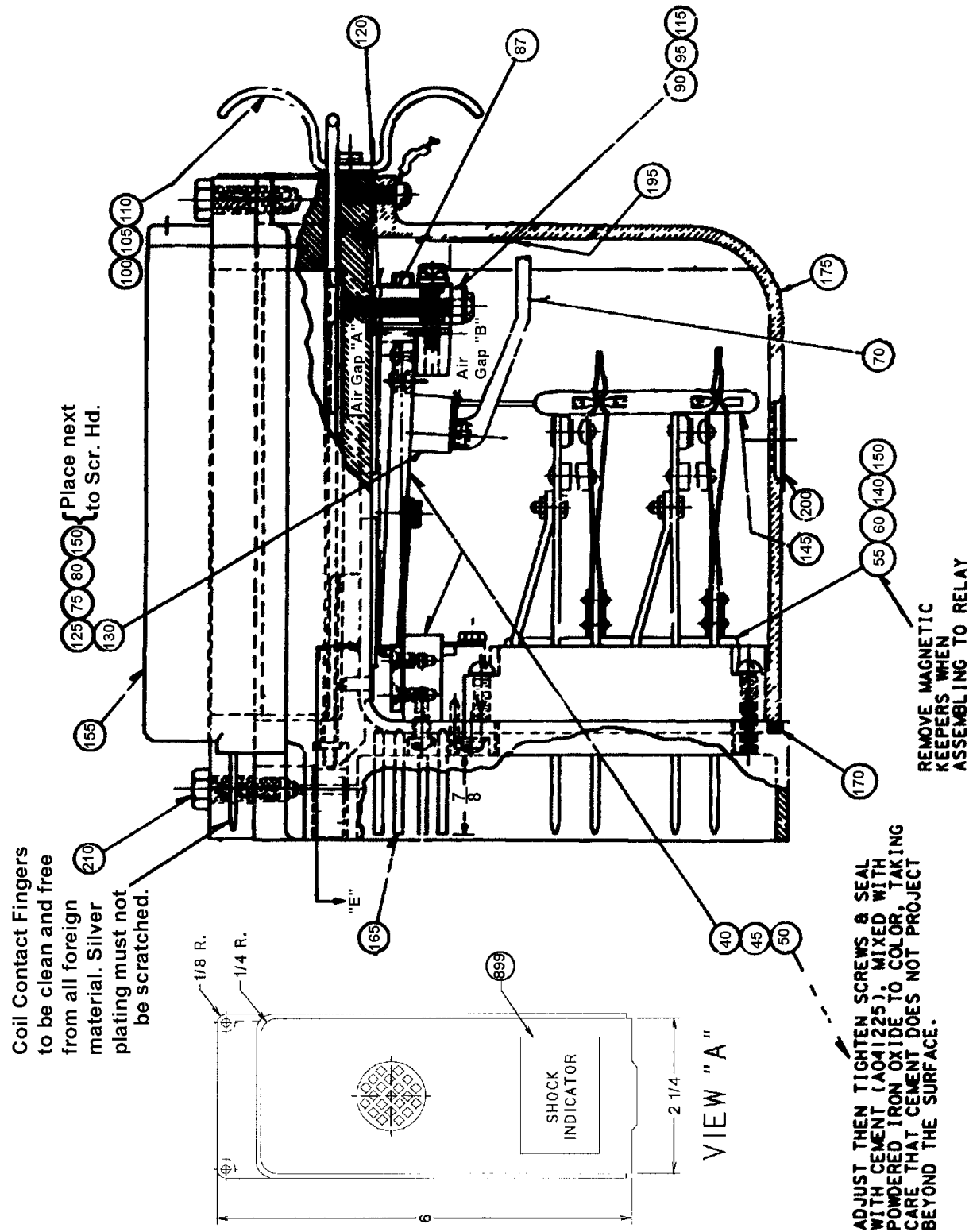


FIGURE A-1(c) PN-150BM RELAY PARTS LOCATION DIAGRAM

**A.1 (continued) PARTS LIST FOR PN-150BM MAGNETIC HEAVY DUTY CONTACT RELAYS (N322517-XXX), (N322524-XXX), (N322525-XXX) SEE FIGURE A1**

Relay	Part No.	Description	Item #
all	M321761	Relay Frame	5
all	M388888	Latch Rod	10
all	M321728	Latch, Machined	25
all	J048716	Pin, Roll SST	30
all	M321861	Spring Plated	35
all	PN375963	Armature	40
all	M291657	Washer	45
all	J052243	Screw, 6-32x7/16 Fil Hd	50
all	N375952	Block Contact	55
all	J052603	Screw, 8-32x7/8 Rd Hd	60
all	M432380	Indicator, Arm. Pos.	70
all	M275388	Nut, .006x5/16 Steel Lock	75
all	J463077	Bolt, 6-32x3/4 Hx Hd Steel	80
all	PM399699	Permanent Magnet Assembly	87
all	M321853	Strap, Magnet Steel	90
all	J792919	Bolt, Lock Monel Met	95
all	J561111	Handle, Pull Aluminum	100
all	J475121-0125	Whsr-SST #10 Shak Pf	105
all	J507296-0129	Scr-SST 10-32x3/8 PH	110
all	J463078	Bolt, 8-32x1-1/4 Steel	115
all	M327179	Screw, 1/4 Hex Hd Bronze Rd	115
all	M347526	Spacer, .0548x48x120 Steel Sht	120
all	M349785	Spring, #26 Phos Bronze Rd	125
all	M376053	Spacer, 1/2 x 7/8 Aluminum	130
all	M312123	Washer	135
all	J047714	Washer-8 Shprf LK SS	140
all	M373632-002	Arm, Operating	145
all	J475121-0127	Washer-SST .170 ID Flt	150
-517	N321647	Coil, Encapsulated (400 Ohms) (See N322517-003)	155
-517	N321647-002	Coil, Encapsulated (1300) (See N322517-004)	155
-517	N333975	Coil, Encapsulated (240 Ohms) (See N322517-001)	155
-517	N377310	Coil, Encapsulated (11/25.5 Ohms) (See N322517-002)	155
-524	N321647	Coil, Encapsulated (400 Ohms) (see N322524-002)	155
-524	N321647-008	Coil, Encapsulated (2730 Ohms) (see N322524-003)	155
-524	N333975	Coil, Encapsulated (240 Ohms) (see N322524-001)	155
-525	N321647	Coil, Encapsulated (400 Ohms)	155
-525	N321647-002	Coil, Encapsulated (1300 Ohms)	155
-525	N333975	Coil, Encapsulated (240 Ohms)	155
-525	N436791-001	Coil, Encapsulated (220/220 Ohms)	155
all	J630776	PL-Aluminum Name	160
all	J487090	Pin, Roll-3/32DX 1-1/8	165
all	J047081	Gasket, Rubber	170

<b>Relay</b>	<b>Part No.</b>	<b>Description</b>	<b>Item #</b>
all	J776596	Cover, Molded Relay	175
all	J507295-0119	SCR-SST 8032x7/16 FH	180
all	A043013	Wire – Seal #23 x 12 SST	185
all	J079351	Seal, Lead	190
all	S003665	Tag	195
all	J790257	Seal, Adhesive Vent	200
-517	N330681-1701	Bag, Parts (for N322517-001)	205
-517	N330681-1702	Bag, Parts (for N322517-002)	205
-517	N330681-1703	Bag, Parts (for N322517-003)	205
-517	N330681-1704	Bag, Parts (for N322517-004)	205
-524	N330681-2401	Bag Parts (N322524-001)	205
-524	N330681-2402	Bag Parts (N322524-002)	205
-524	N330681-2403	Bag Parts (N322524-003)	205
-525	N330681-2501	Bag (For N322525-001)	205
-525	N330681-2502	Bag (For N322525-002)	205
-525	N330681-2504	Bag (For N322525-004)	205
-525	N330681-2506	Bag (For N322525-006)	205
all	J500097-0112	Screw, 1/4-20 x 3/4 Hex Hd SS	210
all	S000456	Tag, Instruction	215
-524	J680167-0012	Shock Indicator (N322524-001 only)	899

**A.2 PARTS LIST FOR OLD-STYLE MOUNTING BASE FOR PN-150BM  
MAGNETIC HEAVY DUTY CONTACT RELAYS (SEE FIGURE A2)**

Item	Part No.	Description	Used on Relay
	N376048 (Note A)	Mounting Base Complete with solder less type receptacle contact springs and mounting hardware	A,B
	N399689 (Note A)	Mounting Base Complete with solderless type receptacle contact springs and mounting hardware	C
	N432995 (Note A)	Mounting Base Complete with solder less type receptacle contact springs and mounting hardware	D
1	N376048-099	Mounting Base Only	A,B
	N399689-099	Mounting Base Only	C
	N432995-099	Mounting Base Only	D
2	J680181	Receptacle contact springs, Solderless Type, for #10 to #12 Wire	A,B,C,D
	J680165	Receptacle contact springs, Solderless Type, for #14 to #16 Wire	A,B,C,D
	J680179	Receptacle contact springs, Solderless Type, for #18 to #20 Wire	A,B,C,D
3		Screw #6-32 x 5/8 Lg. Fil. Hd. Stl. Tin Pl.	A,B,C,D
4		Screw #4-40 x 3/16 Rd. Hd. Type "F" Self-Tapping (Tin. Pl.)	A,B,C,D
5		Screw 1-4-20" x 1-1/4 Lg. Rd. Rd. Stl. Tin. Pl.	A,B,C,D
6		Washer (Not Shown)	A,B,C,D
7		Lockwasher 1/4" Steel (Tin Pl.) (Not Shown)	A,B,C,D
8		Hex Nut 1/4" 20 steel (Tin Pl.) (Not Shown)	A,B,C,D
9	M322965	Meter Test Plug	All
10	J077931	Insulated Test Plug for opening any coil for contact circuit and for removing receptacle contact springs	All

Note A When Mounting Base complete is ordered, a bag of parts 4-1/8" x 5-1/2" is included in the inner carton with the mounting base and instruction prints.

**Bag Contains:**

(2) Tags	(4) #4-40 Scrs. X 3/16" Rd. Hd. Stl. T.P.
(2) Lockwashers 1/4" Steel (Tin Plated)	(2) Flatwashers 1/4" Hx. Hd. Stl. T.P.
(2) Nuts 1/4" Hx. Hd. Stl. T.P.	(2) Washers
(2) Screws 1/4"-20 x 1-1/4 Rd. Hd. Stl.	
(Req. Qty)	Receptacle contact springs (solderless J680165 for #14 to #16 wire. If other wire size is used, request the proper part number shown in Item 2 when ordering base complete (i.e., N376048 except using receptacle contact springs, solderless J680181.

Note B Items 5 to 8 inclusive are for attaching mounting base to rack and are contained in the bag shipped with the "Mounting Base Complete" part number.



**A.3 PARTS LIST FOR IMPROVED MOUNTING BASE PN-150BM RELAYS (SEE FIGURE A3)**

ITEM NO.	PART NO.	DESCRIPTION
1a	N451376-0302	Base Complete for Wayside Relays (14-16 contacts) (Note A)
1b	N451376-0301	Base Only
1c	N451376-0305	Base Complete for Wayside Relays (10-12 contacts) (Note A)
2	J780055	Base-Mounting Molded
3	J792848	Strike-Relay
4	J480280	Nut-Speed Push-On
* 5	M451142-2702	Spring-Cont. Recept.
6	J052667	Screw, 1/4-20 x 1-1/4 Rd.
7	J047775	Washer, 1/4 Sti. Lk. Med.
8	J047501	Washer, 1/4 Stl. Plate
9	J048002	Nut, 1/4-20 IJNC-2B Hvy.
10	J075951	Tag, Relay Identification
11	S000008	Sheet, Instr. Form #8
12	J078399	Bag, Plastic
13	J772383	Extraction Tool (Used for opening any coil or contact circuit and for removing receptacle springs.)

Note A When Mounting Base complete is ordered a plastic bag of parts is included in the inner carton with the mounting base and instruction prints.

Bag Contains: Tags (Item 10)  
Screws (Item 6)  
Items 6, 7, 8 and 9 for attaching mounting base to rack.

\* Included receptacle contact springs are normally (M451142-2702) for #14 and #16 wire, unless otherwise specified. If other wire size is used, the proper part number (M451142-2701 for #18-20; M451142-2703 for #10-12) should be specified when ordering the complete base (N451376-0302, except using receptacle contact springs, solderless M451142-2703).



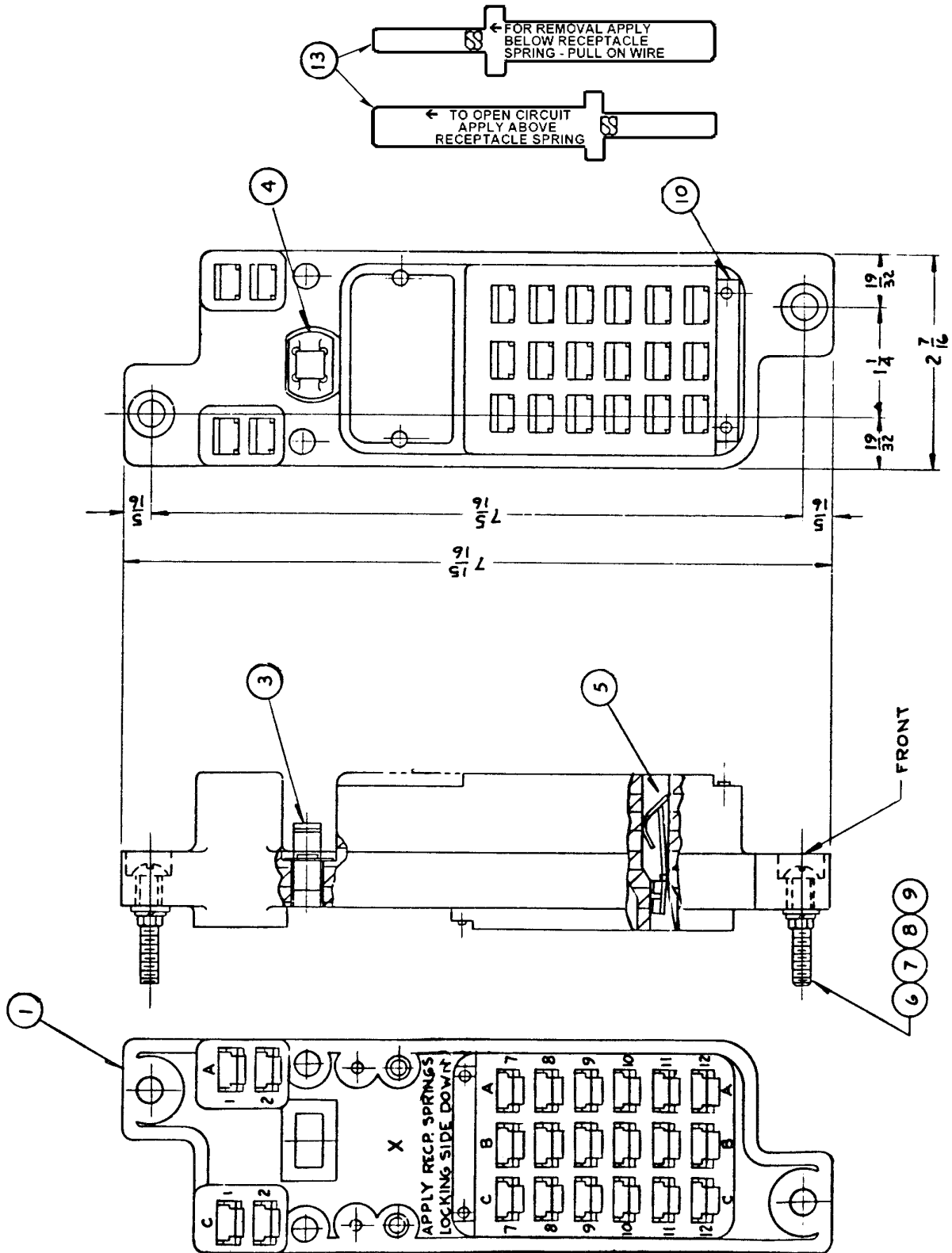


FIGURE A-3. IMPROVED MOUNTING BASE FOR PN-150BM RELAYS

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